REMARKS

In the present Amendment, claim 1 has been amended to recite the components of the means for generating an electromagnetic radiation and the relationship thereof. These amendments are supported throughout the specification, in particular, original claim 3, Figs. 3-5 and page 8, lines 29-31.

Claims have been amended for clarity.

Claims 20-22 have been added. Claim 20 is supported by the specification, for example, original claim 3. Claim 21 is supported by the specification, for example, original claim 4; page 8, lines 6-9; page 9, lines 5-8; and the paragraph bridging pages 9 and 10. Claim 22 is supported by the specification, for example, page 6, line 2-page 7, line 6, and original claims 10 and 11.

Claims 3, 4 and 13-17 have been canceled.

No new matter has been added and entry of the Amendment is respectfully requested. Upon entry of the Amendment, claims 1, 2, 5-12 and 18-22 will be all the claims pending in the application.

I. Response to Rejections Under 35 U.S.C. § 102

a. At page 2 of the Office Action, claims 1, 2, 10-12, 18 and 19 were rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by "High-efficiency luminescent sources fabricated in mesoporous anodic alumina by sol-gel synthesis" (XP009018574) ("XP '574").

Applicants respectfully submit that the present claims are novel and patentable over XP '574 for at least the following reasons.

XP '574 discloses a photo-luminescent device based on the use of porous alumina as a templating structure, for including therein a photoluminescent xerogel. In XP '574, the porous alumina is used to obtain a thicker layer of the active material, with the aim of increasing efficiency of absorption of the excitation radiation, and thus increasing photoluminescence. XP '574 describes using porous alumina as an advantageous alternative material to porous silicon, because alumina is more regular, more easily reproducible and cheaper to obtain.

XP '574 briefly mentions that the alumina structure might exhibit photonic band-gap properties. This is an assumption that the authors made by referring to other works concerning 3D photonic crystals without any further investigation (note that two of the coinventors of the present invention, i.e., Mr. Lambertini and Mr. Repetto, were also the co-authors of XP '574). However, XP '574 does not disclose or suggest that the band-gap properties of alumina can be used for enhancing the efficiency of extraction of light from a substrate.

In this regard, it should be noted that in the device of XP '574, there is no extraction of light from a substrate. This is based on Figure 8 of XP '574, which clearly shows that the substrate merely serves as a support for the layer of porous alumina, in the pores of which, the xerogel is included. In particular, the last drawing in Figure 8 of XP '574 clearly depicts that radiation emitted by the xerogel never passes through the substrate (see, "image observation" in this drawing). Thus, radiation is not intended to pass through the substrate. In addition, excitation is not obtained through electrodes.

Accordingly, XP '574 fails to disclose or suggest:

- means for generating an electromagnetic radiation which comprises two electrodes both in electrical contact with an electroluminescent material,

- generating means which is arranged with respect to the rear surface of the substrate such that the generated electromagnetic radiation passes through the substrate itself and come out of the front surface thereof, and

a layer of porous alumina structured for improving the efficiency of extraction of light from a substrate, as presently claimed.

In view of the foregoing reasons, Applicants respectfully submit that the present claims are not anticipated or rendered obvious by XP '574.

Furthermore, Applicants respectfully submit that XP '574 does not disclose or suggest fluorescent lamps, cathode-ray tubes or flat-panel displays, which are, generally speaking, back-light devices, wherein the electromagnetic radiation or light passes through a transparent substrate or plate. XP '574 merely describes a luminescent device, which has to be frontally excited (see, e.g., Figures 8 and 9), such that light never passes across the substrate to be emitted therefrom. For this reason additionally, Applicants respectfully submit that present claims 11, 12, 18 and 19 are not anticipated or rendered obvious by XP '574.

Accordingly, the Examiner is respectfully requested to reconsider and withdraw the rejection.

b. At page 4 of the Office Action, claims 1, 3 and 5-9 were rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by "Porous alumina based cathode for organic light-emitting devices" (XP009018639) ("XP '639").

Applicants respectfully submit that the present claims are novel and patentable over XP '639 for at least the following reasons.

XP '639 describes a special structure for a light-emitting device having a film of porous alumina arranged between a cathode formed by aluminum and an anode made by ITO.

In XP '639, a layer of aluminum is deposited onto a lower glass element, and then anodised to obtain the film of porous alumina. In this regard, a thin aluminum layer must remain on the lower glass element after anodization, to form the cathode of the device. Organic luminophores are then adsorbed in the surfaces of the pores of the alumina film. Prior to being sealed by means of the upper layer of ITO, the pores are filled with an inert gas to prevent void formation therein. An upper glass element is then provided on the ITO anode.

Thus, the device of XP '639 may include:

- a transparent substrate (assuming, the upper glass element) having a front surface and a rear surface,

- means for generating an electromagnetic radiation, comprising a first electrode (aluminum layer), a second electrode (ITO layer) and an electroluminescent material (luminophores in the pores of alumina), said means being oriented with respect to said rear surface such that the generated electromagnetic radiation passes through the substrate (the upper glass element) to come out of the front surface thereof. In this regard, it should be noted that

light cannot pass through the lower glass element, due to the presence of the aluminum cathode, and

- a layer of porous alumina, which has the mere function of accommodating the active material.

However, XP '639 fails to disclose or suggest the other features recited in the present claims.

First, it is noted that in the device of XP '639, the barrier part of the alumina film, i.e., the non-porous part (see, e.g., attached Fig. 2 of XP '639 with handwritten notations) constitutes an insulating element because alumina is an electrically insulating material.

In fact, the device of XP '639 is specifically designed for operating based on the principle of field emission, according to the *Fowler-Nordheim formula*. Briefly, by applying a potential difference between the aluminum cathode and the ITO anode, emission of electrons occurs from the cathode, which electrons are injected in the volume of the pores of alumina, and then excite the luminophores (see, e.g., Sections 3.2.1 and 3.2.2 of XP '639).

Thus, the electrodes of the device of XP '639 are not, and cannot be, both in electrical contact with the luminescent material, due to the presence of the barrier part of the insulating alumina layer.

In addition, XP '639 is silent concerning the use of the alumina layer for improving the efficiency of extraction of light from the substrate and increasing directionality of the emitted light.

In view of the foregoing, Applicants respectfully submit that the present claims are not anticipated or rendered obvious by XP '639, and thus the rejection should be withdrawn.

II. Response to Rejection Under 35 U.S.C. § 103

At page 6 of the Office Action, claims 4 was rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over XP '639 in view of Utsigi et al (U.S. Pat. No. 5.093,691).

Applicants respectfully submit that this rejection is moot because claim 4 has been canceled.

III. New Claims 20-22

Applicants respectfully submit that new claims 20-22 are novel and patentable over the cited references. Claims 20 and 21 depend from claim 1 and thus are novel and patentable at least by virtue of their dependency. Further, neither XP '574 nor XP '639 disclose or suggest a light emitting device wherein the light emitting means are associated to the rear side of a transparent substrate and the layer of porous alumina is associated to the front face of the same substrate, as recited in claim 22.

Specifically, in the device of XP '574, both the alumina layer and the photo-luminescent material are clearly arranged on the same side of the substrate, i.e. the front side. In this constitution, the electromagnetic radiation does not pass through the substrate.

Similarly, in the device of XP '639, both the alumina layer and the electroluminescent material are arranged on the same side of the substrate, i.e. the rear side of the upper glass. As

explained above, light cannot pass through the lower glass element, due to presence of the aluminum cathode.

That is, both XP '574 and XP '639 discloses that the layer of alumina and the light emitting material must be arranged on the same side of the transparent substrate. Additionally, both XP '574 and XP '639 teach that the light emitting material must fill in the pores of the alumina layer.

IV. Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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Luminescence emission spectra were recorded on SFL-1211A (Solar TII) fluorometer or optical spectral analyser WP-4 (B&M Spectronics). Absorption and reflection spectra were measured with Cary 500 Scan UV-VIS-NIR absorption spectrophotometer made by Varian Ltd. Pulsed Marx electron accelerator with electron energy 200 keV, and current 1 kA, and pulse duration 1.5 ns was used as an electron source. Cross section of the beam near the output window was 0.2 cm^2. The fluorescence light in the last case was passed through a special fiber line to the spectral analyser. Electron beam irradiation of samples was held on air. A relative intensity measurements were made using a usual photomultiplier and digital voltmeter. All measurements were made at room temperature.

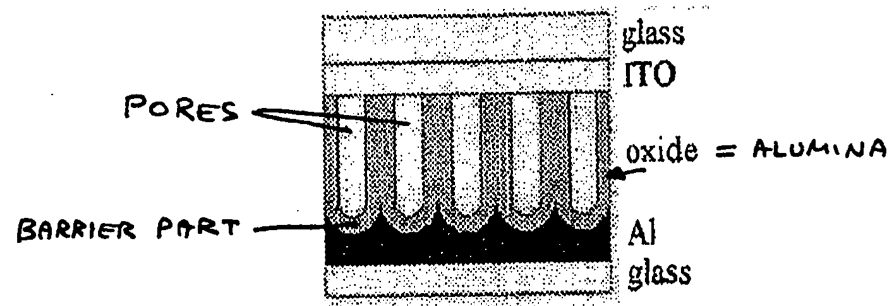

Figure 2. The structure of organic electroluminescent cell

3. RESULTS AND DISCUSSION

3.1. Electron beam irradiation

As the first step we studied radiating properties of perylene or naphthalimide doped anodic porous alumina with a thickness of 1 or 30 microns and average pore diameter of 110 nm under excitation by optical and electron beams (see Fig. 3).

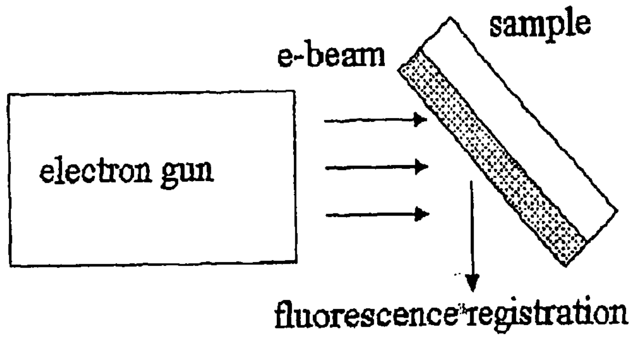

Figure 3. The scheme of measurements with electron beam

Perylene molecules are known to have luminescence spectrum with an obvious vibrational structure, and easy differ from structureless spectrum of porous alumina. The study of their interaction with electron beam is very important, because luminophor molecules in electroluminescent cell are excited by electrons[2, 8]. Porous alumina is known[10] to luminesce in a wide spectral region with a maximum at 430 nm. It was found that in the case of electron excitation the luminescence intensity of perylene is much higher than radiation intensity of the alumina matrix, but in the case of optical excitation their intensities are comparable (fig. 4). Similar results were obtained also with naphthalimide doped porous alumina. After 100 pulses the luminescence intensity does not change, no changes was found also in optical transmission. Other films, especially polymethylmetacrylate copolymers, loose transparency even after one electron pulse irradiation. The difference in radiation intensities in both cases can be explained assuming an avalanche-like propagation of electrons in the pores, which results in luminophor excitation. Such a system works like a microchannel plate. It is known that in thin alumina films a very intensive secondary electron emission is observed after irradiation by fast electrons[14, 15]. The emission coefficient was reached 100-1000 and more. Especially porous structures had a high secondary electron emission coefficient[16]. Electron emission was very inhomogeneous on the surface[14]. Such an emission can also be caused by voltage applied to thin dielectric film[17]. It is interesting to note that this emission can last for some hours after switching off external force. It was absolutely stated that the main factor causing an electron emission in thin dielectric films is a strong electric field[18]. This field is created by surface positive charge appearing after irradiating by electron beam or applied potential. Our experiments with dye doped porous alumina are in a good agreement with studies mentioned above. The